

## Clearfield Sunflowers Stand Tall Against Herbicides

**T**his year marks the second year of sales for Clearfield sunflowers, with U.S. growers forecast to have planted 350,000 acres of the herbicide-resistant crop amid expectations it will streamline the job of weed control.

Clearfield sunflowers owe their herbicide resistance to a wild sunflower (*Helianthus annuus*) accession that Kansas State University weed physiologist Kassim Al-Khatib collected from a soybean field in 1996.

Agricultural Research Service plant geneticist Jerry Miller learned of Al-Khatib's wild sunflower collection from John Nalawaja, a colleague at North Dakota State University-Fargo, and requested seed specimens. Miller germinated eight-leaf seedlings inside an herbicide-spray chamber, and Nalawaja helped test them. They sprayed the seedlings with imazethapyr and imazamox at 2 to 15 times the herbicides' label-recommended rates. Their goal: To identify the healthiest survivors and then transfer the plants' resistance to cultivated sunflower, eventually furnishing growers with a crop that could withstand direct spraying while nearby weeds withered and died.

At the time, 1998, "This prospect was very exciting because the list of broadleaf weeds and grasses controlled by these herbicides was extensive," says Miller, who's with ARS's Red River Valley Agricultural Research Center, Fargo. "Also, for sunflower to expand into no-till acreage, planting resistant hybrids was the only alternative for postemergence weed control," he adds.

From the start, Miller favored conventional plant breeding over biotechnology as a means of passing *H. annuus*'s herbicide-resistance genes into cultivated sunflowers. "We knew that Roundup Ready technology for sunflowers was unlikely to be approved for use in the oilseed and confection crop," he says. "I'd tell growers: 'This is as close to Roundup Ready technology as sunflower will ever get.'" (Roundup Ready refers to Monsanto's herbicide product line

and its genetically modified Roundup-resistant soybeans and corn.)

From 300 wild sunflower specimens, Miller identified 28 that were the most resistant. From those, he chose six to cross with cultivated sunflower, producing five generations of crossbred progeny in 1 year. Each time, he sprayed the sunflower crossbreeds and backcrossed the most robust specimens with the

original cultivated parent plants. Backcrossing eliminated traits Miller didn't want, like branching, which yields multiple flowerheads rather than just one.

Normally, the seed of a pollinated plant needs time to form and pass through a dormancy stage before germinating. But Miller saved time using embryo rescue, a technique that skips such processes by regenerating whole plants from cultures of embryonic tissue. The embryonic tissue produced new seedlings in just 30 days after pollination.

In 2002, Miller and colleagues released two germplasm lines of imazamox-resistant sunflower for commercial seed companies to use in developing their own hybrids. A few companies now market Clearfield sunflowers, which are registered for use only with Beyond, an imazamox herbicide manufactured by BASF Corporation.

The germplasm releases, USDA lines HA 425 and RHA 426, were never intended for production as a stand-alone commercial hybrid. Rather, they (and the hybrid produced by crossing the two lines) serve as benchmarks by which a candidate Clearfield hybrid's resistance is compared en route to being approved.—By **Jan Suszkiw**, ARS.

*This research is part of Crop Production, Product Value, and Safety, an ARS National Program (#301) described on the World Wide Web at [www.nps.ars.usda.gov](http://www.nps.ars.usda.gov).*

*Jerry F. Miller is in the USDA-ARS Sunflower Research Unit, Red River Valley Agricultural Research Center, P.O. Box 5677, Fargo, ND 58105; phone (701) 239-1321, fax (701) 239-1346, e-mail [millerjf@fargo.ars.usda.gov](mailto:millerjf@fargo.ars.usda.gov). ★*